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Sustainable financing of a national Marine Protected Area network in Fiji

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ABSTRACT

Marine Protected Areas (MPA) are mostly studied from an environmental context. A review of available information identified a lack of knowledge in sustainable mechanisms to finance MPA networks. At the United Nations Ocean Conference in 2017, Fiji reaffirmed its voluntary commitment to make 30% of its inshore and offshore marine area MPAs by 2020 under Sustainable Development Goal 14. The work presented here uses empirical data to explore potential benefits from selected community-based MPAs to recipient local stakeholders. A Willingness to Pay (WTP) and Willingness to Contribute Time (WtCT) method was used to explore the extent to which bottom-up governance systems represent a potential financing mechanism of a MPA network. Results of 115 interviews concluded that proximity to a fishing market, dependence on marine resources, food security, income and international commitments were significant variables influencing stakeholder's WTP and WtCT to manage a MPA. We argue that there is a discrepancy between WtCT and WTP driven by income constraints. Thus, by using WTP and WtCT to support financing of a MPA network, a Provincial Trust Fund (PTF) could promote an equitable and benefits-based contribution. Equally important, a PTF has a polycentric and decentralized governance model, which endorses sustainable management of traditional fishing communities. The conclusions provide insight into a bottom-up approach for long-term financial sustainability of Fiji's national MPA commitments.

1. Introduction

By 2060, global projections estimate more than one billion humans worldwide will live in coastal zones (Tilman et al., 2017). The populations at greatest risk to sea-level rise and unsustainable use of marine resources includes Small Island Developing States (SIDS). SIDSs marine environment are susceptible to anthropogenic pressures like overfishing and climate change (Eastwood et al., 2016). To combat these pressures, the government of Fiji has committed to using MPA's as a tool to reduce poverty, improve food security and protect biodiversity (Yap et al., 2016).

MPAs can be defined as: 'explicit areas of ocean where human activities are regulated or prohibited' (Eastwood et al., 2016). Government–managed MPAs can rebuild small fish stocks but have been severely criticized for disregarding resource users and creating conflicts (Chirico et al., 2017). In Fiji, inshore MPAs have been framed to maximize fisheries benefits while spreading costs as equitably as possible amongst communities (Weeks and Jupiter, 2013). However, MPAs as a term has limited saliency in Fiji and "Marine Managed Area (MMA)" is preferred by many stakeholders (Diedrich et al., 2017). This is because indigenous peoples of the South Pacific have a deep connection with the sea which encompasses reliance on ocean resources for food and livelihoods. These inhabitants have deep-rooted customary laws related to the ocean which includes safeguarding inshore marine areas (*iqoliqoli*) (Friedlander et al., 2016). The most frequently implemented management tool within MMAs is periodically harvested closures, which are fisheries closures with opening regimes ranging in restrictions (Cohen and Foale, 2013).

The unique nature of marine resources in the *iqoliqoli* contributed to the formation of Fiji Locally Managed Marine Areas (FLMMA) (FLMMA, 2015). FLMMA is a network of government, non-government and community partners linking villages with formal and informal marine management efforts (Govan et al., 2009; Aalbersberg et al., 2005). Accordingly, success of FLMMAs pays close attention to resource users being involved in MPA design, implementation and enforcement (Chirico et al., 2017).

In line with MMAs, Fiji's National Green Growth Framework and the National Biodiversity Strategies and Action Plan (NBSAP) (Ministry of Environment, 2007) provides key linkages between national policy objectives and strategies to support an MPA network (Yap et al., 2016).

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This includes permanence with long-term protection in mind and, resilience of the marine environment. The NBSAP framework and action plan are legal commitments reaffirmed at the SIDS conference in 2014 to protect 30% of Fiji's seas by 2020 (Yap et al., 2016). As of December 2013, 16.6% of coastal waters were effectively protected through community-based management schemes.

The marine ecosystem and fisheries play a central economic and social role in Fiji (Gillett, 2016) worth more than FJD2.6 bill (USD $13.04 bill) per year (Yap et al., 2016). In many areas of the world the most acute problem facing developing states is poverty, which sequentially has been the primary cause of environmental degradation. But the Fijian population have not traditionally suffered from stark poverty, which has been circumvented due to the prevalence of subsistence livelihoods (Gerbeaux et al., 2007). Marine resources collected from traditional fishing grounds (*iqoliqoli*) have historically been the main source of protein for native people, with any excess harvest being sold. This is expected to remain the case in the future (Techera and Troniak, 2009).

That being said, Fiji has been assisted by the Marine and Coastal Biodiversity Management in Pacific Island Countries (MACBIO) Project implemented by German Agency for International Cooperation (GIZ) and the International Union of Conservation and Nature (IUCN) as the main technical input. They aim to strengthen the sustainable management of marine and coastal biodiversity (Berthold, 2016). A critical gap identified by the MACBIO project is potential sustainable financing mechanisms used to maintain a MPA network. Worldwide, implementing sustainable financing mechanisms for MPA management is a challenge, especially in SIDSs' like Fiji (Weeks and Adams, 2018). Common sources of funding for MPAs can be local and/or international and include government budget support (Bos et al., 2015), non-government organizations (Binet et al., 2015), user fees (Vianna et al., 2011), ecotourism (Fronseca, 2009) and donations (Reid-Grant and Bhat, 2009).

Diversifying sources of financing is critical for financial sustainability and protection of marine resources. This will protect Fiji's government against over-reliance on a single source of funding, and on donor support. Non-monetary techniques advance prominence to the subsidies provided by nature to society: i.e. cultural, educational, moral, historical or spiritual values of ecosystem services (Portman et al., 2016). This study was driven by the need to develop social but not inevitably monetary techniques for investigating the fundamental incentives behind biodiversity conservation and MPA financing mechanisms.

In order to achieve financial sustainability of a national MPA network, it is critical to take into consideration the need to increase the capacity to self-generate additional revenue at the national level. On the other hand, it is equally important to improve the institutional capacity to adequately manage financial resources and enable reliable long-term funding. Thus, the use of socio-economic criteria is especially important in the context of SIDSs where social acceptance is a critical factor in determining MPA success (Ban et al., 2009). When considering a holistic approach to funding MPAs, the use of innovative financing mechanisms like Willingness to Contribute Time (WtCT) rather than money to manage a MPA should be considered. WtCT characterizes the connection between ecological processes and coastal societies (O'Garra, 2009) through socio-cultural links to community. Previous studies have examined how to finance MPAs by using foreign assistance (Gurney et al., 2015) which has proven to be more financially resourceful than national budget (Gurney et al., 2015). However, to date, there is no study in Fiji on sustainable financing of MPAs.

By using a Contingency Valuation (CV) this study will assess how use and non-use ecosystem services can contribute to financing of a national MPA network. The CV approach attempts to estimate the value of ecosystem services to community stakeholders (McFadden and Train, 2017). It is a unique way to assign dollar values to non-use values of the environment-values that may not involve direct participation. Current literature proclaims that the CV approach lacks the empirical evidence to develop economic values due to a theoretical line of questioning (Christie et al., 2012). However, despite this criticism, CVs are the foundation for policymaking countries (e.g. USA) and can support current communal payment systems in place (Merkl et al., 2003). That being said, overall, little attention has been given to a more in-depth assessment of the CV approach in Fiji and the value it may have in financing a MPA network. Given locals' irreplaceable rights situation, it is important to elucidate unique financing mechanisms for MPAs.

Community-level resource governance must be considered in financing a MPA network (Francisco, 2016). Tanya O'Garra (2009) conducted a CV study in Fiji estimating the non-use values of a traditional fishing ground to local communities 10 years ago. O'Garra's (2009) methodology was used for this study because of the repeatability of study sites and lack of attention to cultural ownership of inshore MPAs amongst coastal communities. This reflects the traditional view that subsistence groups are 'too poor to be green' and thus alterative-funding methods for the marine environment must be considered. This study aims to assess stakeholders Willingness to Pay (WTP) and/or Willingness to Contribute Time (WtCT) to manage the *iqoliqoli* as a potential financing mechanism for inshore MPAs. These results will provide recommended financing mechanism which could contribute to management costs of Fiji's MPA commitments.

2. Methods

A case-study approach was adopted for collection of empirical data. This provided a description of socio-economic characteristics, MPA benefits, and WTP and/or WtCT for MPA management. Seeing that the focus of the survey is on low-income developing communities in Fiji, we limit our discussion of financing options to those that are available and realistic in SIDSs. Key informants are important for this study because of the knowledge regarding national commitments and priorities that local stakeholders are disconnected from. Key informant interviews distinguished five beneficiary groups; (Youth, Head of Village, Household (Women), Subsistence Fishermen, Commercial Fishermen) (n = 115) (Table 1). The five beneficiary groups are critical for this study because of their consumptive and cultural reliance on the inshore marine environment. Considering the 2020 national commitments and this study focusing on financing of an inshore MPA network, beneficiaries and key informant will be used in combination for analysis. Key informants were used to gain an overview of relevant benefits and local stakeholders WTP/WtCT to manage MPAs. Selecting interviewees

Table 1
Explanatory design of 115 interviews on 3 islands in 4 or 5 communities per island (site). Five stakeholder groups (n = 115) were interviewed in communities showing a broad range of data.

Stakeholder groups	Sites			Total
	Navakavu community (n = 36)	Gau Island (n = 46)	Macuata *qoliqoli* Cokovata (n = 33)	
Youth	9	20	9	38
Heads of Village	6	6	8	20
Household (Women)	9	12	10	31
Subsistence Fishermen	6	5	1	12
Commercial Fishermen	6	3	5	14
				115

at the community level was completed using convenience and snowball sampling. Three principle sources of information were used: (1) a desk-based review of literature assessing global case studies for reported MPA benefits and recipient stakeholder groups (2) interviews with key informants, (3) community-based surveys yielding quantitative data (Appendix 1).

2.1. Literature review

A literature review was completed to identify types of benefits and recipient beneficiaries of MPAs, the socio-economic values of marine resources beyond the traditional consumptive use and assess existing frameworks on ecosystem service benefits. Lessons from this review were used to build a better understanding of the relationship between MPAs, ecosystem services and human-wellbeing for SIDSs. This review created a wide framework of MPA benefits and recipient beneficiaries on a global scale. We then contextualized MPA benefits, beneficiaries and ecosystem services to a Fiji specific scale with the support of key informants.

2.2. Survey sites

Key informants identified applicable study sites supported by current peer-reviewed literature ($n = 13$) (McMillan et al., 2014). All key informants have prior connection and/or a close relationship to people and place within Fiji. Those identified have knowledge of the study sites, can introduce visiting researchers to the people needed to approve of our presence, and can contextualize current marine conservation in place (McKenna and Main, 2013). Key informants provided important insight into three factors determined as critical for each study site-their geographical location (coastal community), an existing *tabu* area (MPA) and a fishing culture (subsistence or commercial) (Weigel et al., 2014). Not only were key informants' integral to identifying survey sites but also, interpreting survey data. Key informant interviews were used to support survey responses because of their heightened knowledge and understanding of SIDSs national commitments that survey respondents were unfamiliar with.

Three sites were selected: Navakavu community ($n = 36$) (Fig. 1A) a Fiji Locally Managed Marine Area (FLMMA) network located on the Muaivuso peninsula, 13 km west of Fiji's capital Suva; Gau Island ($n = 46$) (Fig. 1B) inhabitants live a customary semi-subsistence livelihood, and Macuata *Qoliqoli* Cokovata ($n = 33$) (Fig. 1C) a commercial fishing province influenced by international support. The proximity of sites to a local fishing market or lack thereof, reliance on fish for livelihood and income and, current marine management in place (a *tabu*) distinguish the different types of coastal localities chosen for interviews in Fiji.

2.3. Key informant interviews

Key informant interviews were completed by professional stakeholders at the provincial and national level. Representatives from relevant ministries or departments (e.g. fisheries and environment), civil society (e.g. NGOs and international organizations) and academia were interviewed ($n = 13$). A set of open-ended questions was designed to elicit information on the function of MPAs, recipient benefits and beneficiaries in Fiji. Selecting interviewees at the community level was completed using a collaborative process. Initial data acquired from key informants was used to select stakeholders at the community level. The data was analyzed qualitatively to create a list of 19 MPA benefits (Table 2). Key informants identified 19 MPA benefits as critical to community stakeholders' livelihood and wellbeing. Question phrasing was suggested by key informants as a way for respondents to contextualize and understand benefits in relation to their livelihoods.

2.4. Marine Protected Area benefits survey

Key informants identified 19 benefits associated with MPAs and *iqoliqoli* areas (Table 2). In order to determine MPA benefits, recipient stakeholders ranked 19 benefits between 1 and 3 across study sites (1 = very important, 2 = important, 3 = unimportant) (Fig. 2). The rankings were used to provide a level of verification in the process of how valuable MPAs are to each stakeholder (Portman et al., 2016).

The purpose of the survey was to decipher which MPA benefits were most important to recipient stakeholders. This was used as justification for potential financing avenues. At the community level, 14 villages were surveyed, and five stakeholder groups were interviewed in person at each village (Table 1) ($n = 115$). On average, 8 interviews were completed per village. Completion of each survey took an average of thirty minutes and was piloted by the Chief of Navakavu community. In order to gain trust from the community and as a result honest survey answers, we worked with translators from the local region. The use of a translator made phrases culturally appropriate so as not to offend inhabitants, and contextualize terms like 'MPA benefits' to 'resource use' as analogues. The translator was used as a way to convey the best possible interpretation of the survey for interviewees. Many interviews were transcribed (recorded), translate to English and analyzed qualitatively and quantitatively.

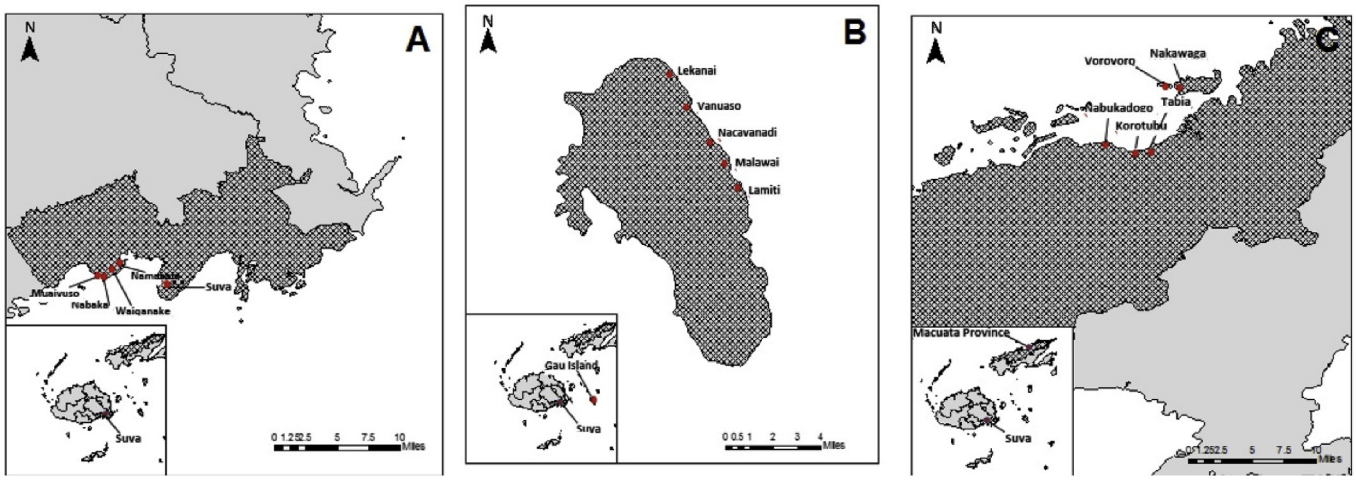

Fig. 1. Study sites in Fiji. All villages studied are highlighted in red. All villages are within the same *iqoliqoli* and have or previously had a *tabu* (Weigel et al., 2014). (A) Navakavu community, (B) Gau Island, (C) Macuata *Qoliqoli* Cokovata. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Table 2
19 Marine Protected Area benefits in Fiji created from key informant interviews. Right column were questions adopted for community surveys. Left column were ecosystem services identified as critical to community stakeholders livelihood.

Benefits of Marine Protected Areas	Define- How MPA benefits apply to each respondent
International recognition	Internationally obligations such as Aichi Targets, SIDS Goals- Being recognized internationally is one of the ways we benefit from the ocean, do you think this applies to you or your village?
National commitment to protect the MPA	Government commitment to protect your reefs is a benefit, do you think it is important for the government to make this commitment? Now, for your village, do you think you benefit from this commitment?
Income from fishing	A benefit from the *tabu* is the increased income we get from fishing; do you think this applies to you or your village?
Easy access for fishing	Easier access to fishing grounds is a benefit, do you think this applies to you or your village?
Increase wealth	A benefit is the increase of wealth from the *tabu*, do you think this applies to you or your village?
Building community needs e.g. village hall, canteen	A benefit from the *tabu* is that some development in the village like building community halls can be achieved, do you think this applies to you or your village?
Researchers	A possible benefit is that researchers (like me) come and visit the village, do you think this applies to you or your village?
Eco-tourism	Do you have tourism in your village? If yes, do you benefit from eco-tourism?
Increase food source	A benefit from the *tabu* is the increase of food source, do you think this applies to you or your village?
Provide employment opportunities	A benefit is that employment opportunities can be created, do you think this applies to you or your village?
Increase standard of living (better lifestyle)	A benefit is that the *tabu* can or will lift the standard of living, do you think you or you village benefit from this?
Use resources to honour traditions	A benefit is that traditional obligations can be met from extractive or non-extractive use of the ocean, do you think this applies to you or your village?
Increase health of people in the community	A benefit is that the health of people is increased (access to better health services and healthy food), do you think this applies to you or your village?
Brings community together	A benefit is that the *tabu* brings the community together to collectively deliberate on issues and matters arising, do you think this applies to you or your village?
Strengthen leadership of chief	A benefit is that a *tabu* can strengthen the leadership hierarchy? Do you think this applies to you and your village?
Educate people	A benefit is that the *tabu* educates people with the necessary knowledge in terms of resources. Do you think this applies to you or your village?
Increase fish size	A benefit is that size of the fish increase from having a *tabu*, do you think this applies to you or your village?
More fish	A benefit from the *tabu* is that there is increased fish abundance, do you think this applies to you or your village?
Appreciation of the environment	A benefit is that the *tabu* changes the perception of peoples thinking of the marine environment. With the conservation work you have been doing or are involved with, do you think this applies to you or your village?

2.5. Willingness to pay and willingness to contribute time for managements of Marine Protected Areas

Following the MPA benefits survey, the CV approach was used to consider three communities WTP (FJ$/month) for management of in-shore MPAs (*iqoliqoli*). The valuation scenario was modelled from Tanya O'Garra (2009) because of the valued monetary and time-based contributions to finance a MPA network. It was considered that the five stakeholder groups may be unwilling to pay due to semi-subsistence livelihoods or lack of money (Rohe et al., 2017). O'Garra's (2009) approach supported humans who have little or no money to fund the MPA network. Thus, respondents were asked their WtCT (h/week) to manage the MPA network and benefit future generations. Any zero WtCT or WTP was followed up with an open question of why they were not willing to support the MPA network. This approach does have limitations including the survey design not presenting an incentive compatible mechanism to fund this public good.

In many cases where resources for regulation and enforcement are lacking, conservation activities involve community participation through voluntary assistances by resource users (Weeks and Adams, 2018). These contributors can be in the form of time or money. Very little is known about the vast choices of resource users and how it may relate to supporting public goods such as marine ecosystems (Fehr and Fischbacher, 2002). McClanahan et al. (2006) provides evidence that marine management systems devised to meet community goals can be more successful than those designed for biodiversity conservation.

MPAs in numerous countries are financed from tax revenues but poor countries like Fiji often have little governmental financial support for conservation initiatives, thus a large percentage of conservation resources must be sourced privately by other stakeholders. Previous

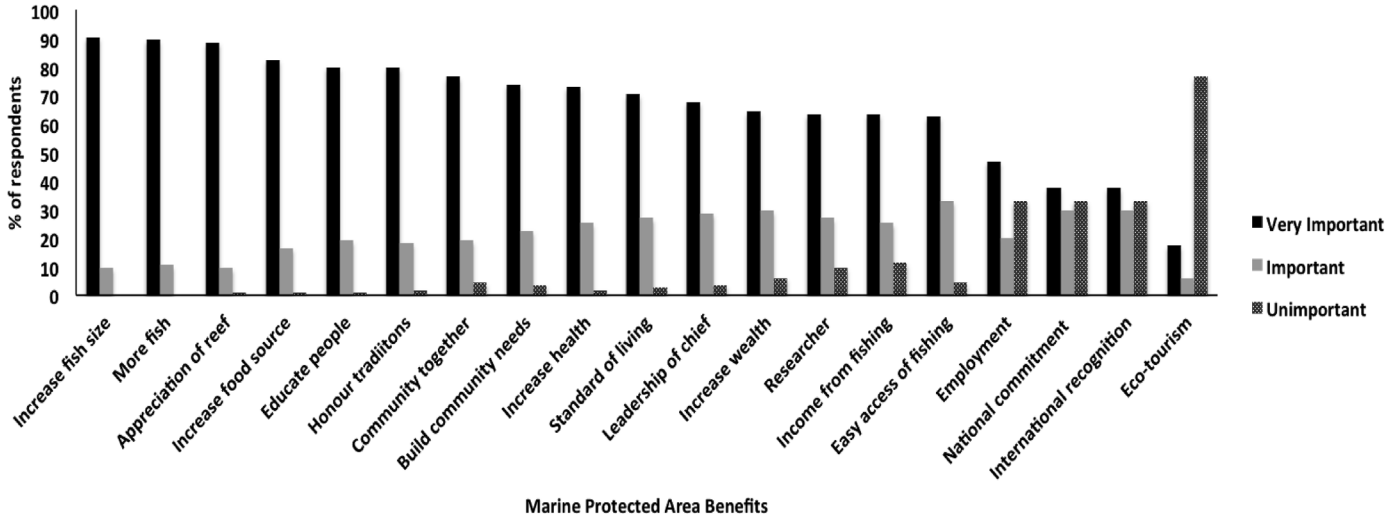

Fig. 2. Percentage of each respondents' rankings given for the 19 benefits of a MPA from 1 = very important, 2 = important, 3 = unimportant. Left to right; most valued benefit to least valued benefit.

studies signify that different socioeconomic characteristics can affect the type of support preferred such as time. Given the direct impact of environmental goods on resource users, understanding users' ability and willingness to contribute to implementing MPAs is important.

2.6. Converting willingness to contribute time into economic estimates

Mean WtCT values were converted into monetary values. It was considered by O'Garra's methodology that time afforded to management of the MPA involves an 'opportunity cost' and thus a financial value (O'Garra, 2009). We calculate opportunity cost as a weighted sum (min. wage rate) to capture the distribution of stakeholders and how opportunity cost data allows for consideration of future effort (Adams et al., 2010). This may be preferable to community stakeholders who need to evaluate selections based on potential and/or current MPA management effort. The use of wage rate ascertains that respondents are making a compromise between work time and time used to managing the MPA. The economic value of WtCT was estimated using the following formula:

Mean WTP = MeanWTCT*wage rate

Using the national minimum wage rate of Fiji as of July 2015; FJ $2.32/hour (USD$1.16) (Ministry of Employment, 2015) an opportunity cost of time afforded to MPA management was estimated (section 4.6). This measure is used as an opportunity cost because of the allowable comparison to a similar study by O'Garra (2009). This will permit an assessment of changes in respondents WtCT over 10 years. By using opportunity cost models, we can provide data that can directly be used in decision support tools at the national government level (Watts et al., 2009).

2.7. Data analysis

We used quantitative and qualitative methods to explore the relationships between perceived MPA benefits and WtCT/WTP values to manage the MPA network. Descriptive analysis was used to ascertain which MPA benefits were most valued by respondents. A Principle Component Analysis (PCA) was then completed to examine the relationship between benefits and stakeholder groups (Fig. 3). A PCA is considered a robust analysis for use of categorical data with large datasets (Jolliffe and Cadima, 2016). Consequently, PCAs accommodate data measured at different scales with multiple interactions.

To identify independent variables influencing WTP and WtCT, we used a Multivariate Discriminant Analysis (MDA). We then examined the relationship between MPA benefits and financing mechanisms by assessing the link between MPA benefits, five stakeholder groups, and respondent WtCT and WTP values.

3. Results

3.1. Marine Protected Areas benefits

A total of 115 interviews covering five stakeholder groups across three sites were completed between June–August 2016. Frequency of respondents valuing the 19 MPA benefits is illustrated in Fig. 2. Each benefit was ranked from very important to unimportant. Benefits valued most important by respondents were: 'increased food source' 'increase fish size', 'more fish' and, 'appreciate of reef'. 'International recognition' and 'national commitment' were considered unimportant by one third of respondents. 'National commitment' was considered unimportant by over two thirds of subsistence and commercial fishermen. 'Ecotourism' was considered unimportant by 77% of respondent's due to lack of tourism within communities. 33% of respondents ranked 'employment' as unimportant due subsistence or semi-subsistence livelihoods, and reliance on marine resources for consumptive use rather than for income. However, subsistence and commercial fishermen reported they rely on fishing resources is for income and food security. All 20 Heads of Villages mentioned that marine resources are their primary source of livelihood.

Benefits can be perceived in different ways by all stakeholders. Most respondents valued economic and social benefits as most important while political benefits were not valued equally by stakeholders. A key finding was the lack of importance attributed to international and national commitments surrounding MPAs. The majority of stakeholders valued economic (increased fish size, more fish) and social benefits (appreciation of reef) as most important.

Ranking scores highlighted that Youth and Heads of Villages valued MPA benefits highest (Fig. 3). Many of the Youth were also considered to be subsistence and/or commercial fishermen.

To assess the relationship between MPA benefits and five stakeholder groups (Fig. 4), a PCA was completed. Results of KMO Bartlett's Test of Sphericity is p = .000 exhibiting a statistically significant correlation in the matrix.

The PCA highlighted complex differences between MPA benefits, local stakeholders and three Fijian Islands (Fig. 4). It demonstrated two main axes of variation within the fishing communities; (i) fisheries resource and traditions, and (ii) social and economic benefits. Following PC1 there is independent axis between MPA benefits, the resource base and the way it affects communities. 'International recognition' and 'honoring tradition' share an inverse relationship suggesting a perceived play-off between international conservation ideals and traditional fisheries. The unimportance of 'international recognition' for

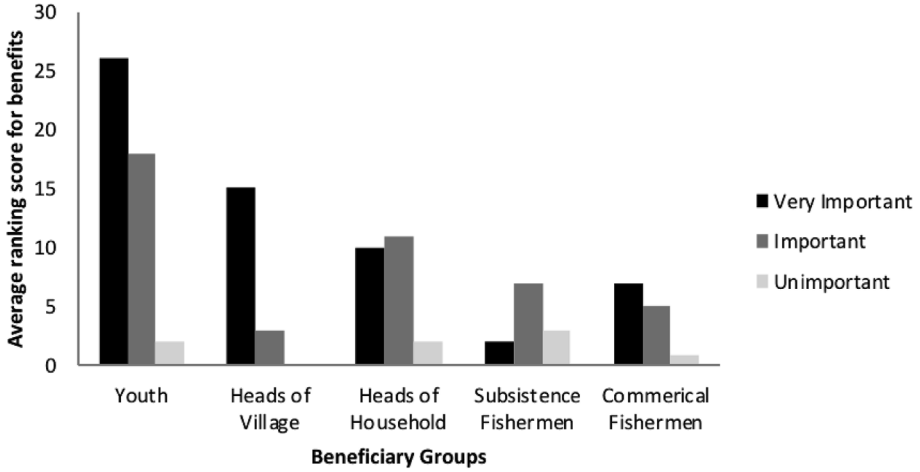

Fig. 3. Average number of responses of each benefit ranking from very important, important and unimportant for each beneficiary group.

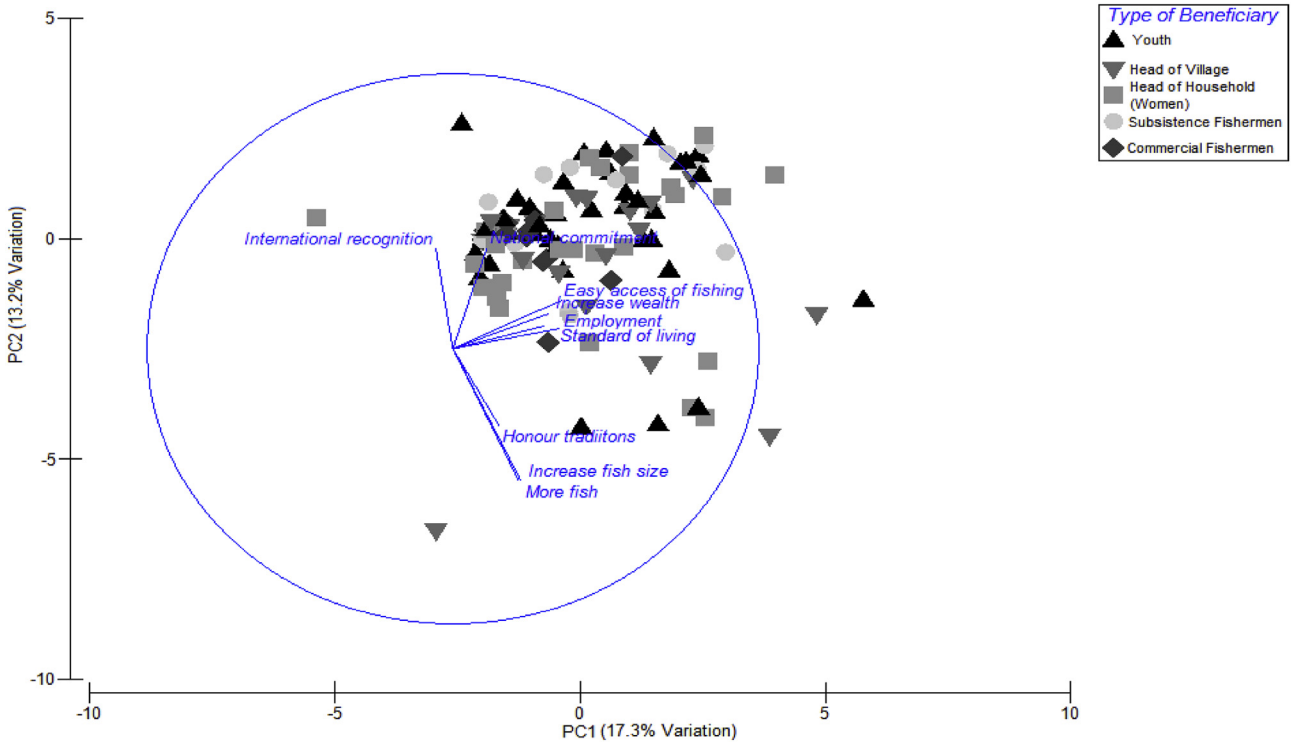

Fig. 4. Principle Component Analysis (PCA) plot on MPA benefits: Scores of the first and second principle component. The shading of samples is proportionate to the stakeholder groups (grey shapes) and the labels proportioned to MPA benefits.

local stakeholders is highlighted as a key finding from the PCA. The shapes (stakeholder groups) are proportional and highly correlated to social ('standard of living') and economic MPA benefits ('employment').

3.2. Communities willingness to contribute time to Marine Protected Area management

All respondents (n = 115) were asked whether they would be WtCT to manage an MPA for future generations and personal benefit. Results of WtCT (Fig. 5) show that stakeholders are willing to contribute between 2.42 and 5.43 h/week to manage the MPA. All stakeholders considered the *iqoliqoli* to be very important. According to these respondents, protecting the *iqoliqoli* for future generations was worth their time. In Table 3, average WtCT by stakeholders is 4.6 h/week. Of all respondents interviewed, 93.9% of respondents WtCT were greater than zero.

Table 3
Summary statistics for all six stakeholder groups WtCT (hrs/week) for management of the *iqoliqoli* as a potential financing mechanism for inshore MPAs.

Summary statistics	Responses = (n = 115)
WtCT > 0 (% sample)	93.6
WtCT = 0 (%sample)	6.1
Mean WtCT (hrs/week) (s.d.)	4.6 (4.8)
Minimum/Maximum	0/25

According to results, 6.1% of respondents were unwilling to contribute time or did not have the time to manage the MPA (Table 3).

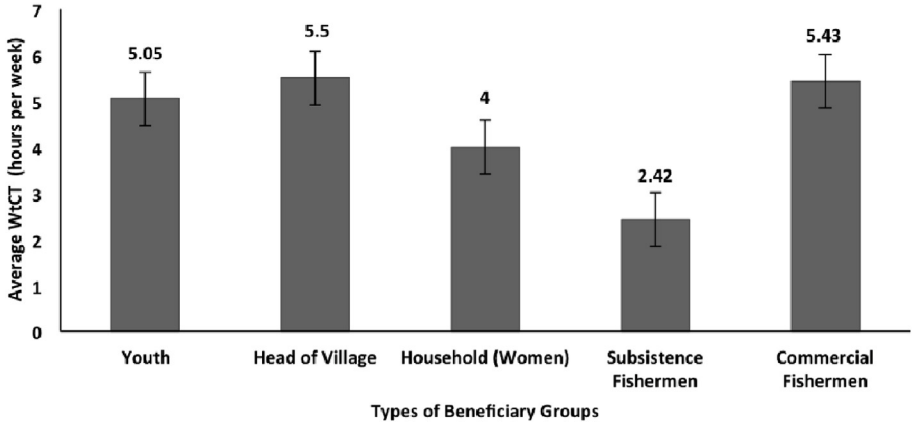

Fig. 5. Average WtCT hrs/week MPA management. by each stakeholder group to decipherstakeholder groups potential costings for inshore MPAs. Show standard error bars.

Table 4
Summary statistics for all five stakeholder groups WTP (FJ$/month) for management of the *iqoliqoli* as a potential financing mechanism for inshore MPAs.

Summary statistics	Responses = (n = 115)
WTP > 0 (% sample)	17.4
WTP = 0 (%sample)	82.6
Mean WTP (FJ$ per month) (s.d.)	9.5 (34.5)
Minimum/Maximum	0/200

Respondents that were WTP were of old age with health problems or had occupations outside the community.

3.3. Communities willingness to pay for Marine Protected Area management

In order to evaluate if respondents had a preference in financing mechanism, they were asked to contribute money to MPA management. Most respondents were not WTP for MPA management. Summary statistics in Table 4 confirm that 82.6% of respondents were unwilling to pay for MPA management. When asked why they were unwilling to pay, the majority of respondents (82.6%) had little or no income, prefer labor to money or were unsure of how their money would be used (Table 4).

Explained in Table 4, 17.4% of respondents were WTP for MPA management. Due to an income independent from community needs, 10 commercial fishermen and eight youth preferred to pay (Fig. 6). According to interviewees, this income was earned without the expectation of providing solely for the community. Heads of villages, heads of household (women) and subsistence fishermen were WTP due to old age or bad health (Fig. 6).

3.4. Discriminant analysis of willingness to pay and willingness to contribute time for Marine Protected Area management

The MDA was carried out between priori groups (Low (1 = 0–77.3 FJ$/month), Medium (2 = 77.4–154.6 FJ$/month), High (3 = 154.7–232 FJ$/month)) using 29 descriptor variables (Appendix 2). This was used to determine the key factors influencing WTP and WtCT to maintain a MPA network (Fig. 7). WtCT responses were converted into monetary values using minimum wage rate (sect. 2.6). WTP and WtCT values were scaled up to FJ$/month and analyzed simultaneously. This extrapolation was used to find logical differences in descriptive parameters between the priori groups.

Using 29 variables obtained from the community-based fieldwork, the Canonical Discriminate Analysis (CDA) clustered samples into three

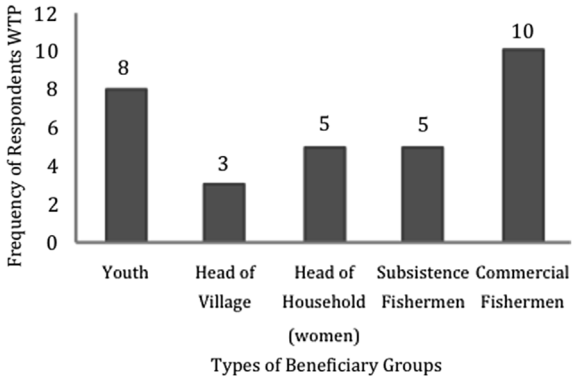

Fig. 6. The frequency of each beneficiary groups WTP(FJ$/month) for MPA management (*iqoliqoli*).

groups of WTP (Fig. 7) (Appendix 2). Given the existence of the three WtCT and WTP groups, Table 5 shows variables influencing the relationship between WtCT and WTP. Specifically, proximity to a fishing market or lack thereof, dependence on marine resources, food security, income and international commitments.

A posteriori classification using Multivariate Discriminate Function (DF) 1 and 2 permitted 92.2% classification success. The variables were plotted on two function axes in Fig. 7. Attention was focused on coefficients of DF with values > 0.4 on an absolute scale. A high positive value along DF1 was because of 'More fish' and 'Researcher' and, to a lesser extent, 'FLMMA Community', 'Remote Island Community', 'Employment' and 'Increase fish size' responses (Table 5). A positive value along the DF 2 is the result of 'Youth' and 'Increase fish size' and, to a lesser degree 'More fish', 'Household (Women)', 'Head of Village', "FLMMA Community' and 'Remote Island Community' of the WTP and WtCT responses (Table 5).

The centroid of Group 1 is well separated from that of group 2 and 3 along DF1 axis. Group 2 and 3 are far apart when their centroids are projected along DF2 axis (Fig. 7). Group 1 and 2 are identified as heads of villages, household, youth and subsistence fishermen while Group 3 is identified as commercial fishermen due to the WTP value being increasingly higher. Group 3 is outstanding with reference to either axis in the two-dimensional plot. In essence, the separation between Group 1 from 2 to 3 is due to the higher value of 'more fish' and 'researcher' along DF 1 (Table 5). On the other hand, 'Youth' and 'Increase fish size' are influencing the differences between WtCT and WTP along DF2 (Table 5).

CDA was used to explore if beneficiaries could be correctly reassigned to their source group (Fig. 7). The strongest observed characteristic differentiation of WtCT and WTP was found between group 1 and 3 which was strongly correlated to beneficiary groups: Youth, Heads of Villages and Heads of Households (Table 5). Thus, there is a strong correlation between the three beneficiary groups WtCT and WTP.

3.5. Comparing and aggregating willingness to contribute time and willingness to pay estimates

Section 2.6 produced an equation for economic estimates of WTP and WtCT. Results indicate (Table 6) that when using WtCT, the opportunity cost respondents are willing to contribute towards MPA management comes to an average of FJ$554.94 (USD$278.47) per individual per year. This value is more than five times the directly estimated WTP value of FJ$114.00 (USD$57.20) per individual per year. By taking into consideration the subsistence or semi-subsistence livelihood of all respondents, WtCT could be a more valuable source of funding revenue for MPA management.

4. Discussion

This study attempts to identify possible financial mechanisms for MPAs other than the traditional direct government budget support. There are numerous financing options available when considering the use of WtCT and WTP. This discussion provides; first, an analysis of significant MPA benefits and stakeholder groups. This will determine links between benefits and costs to maintain the MPA network. Second, using WTP and WtCT results, a Provincial Trust Fund (PTF) is considered as a financing mechanism for inshore MPAs. A PTF is a source of sustainable financing for long-term biodiversity conservation, in particular for protected areas management (Bladdon et al., 2014). The discussion aims to identify the discrepancy between WtCT and WTP driven by income constraints which as a result has direct implications for potential MPA financing mechanisms.

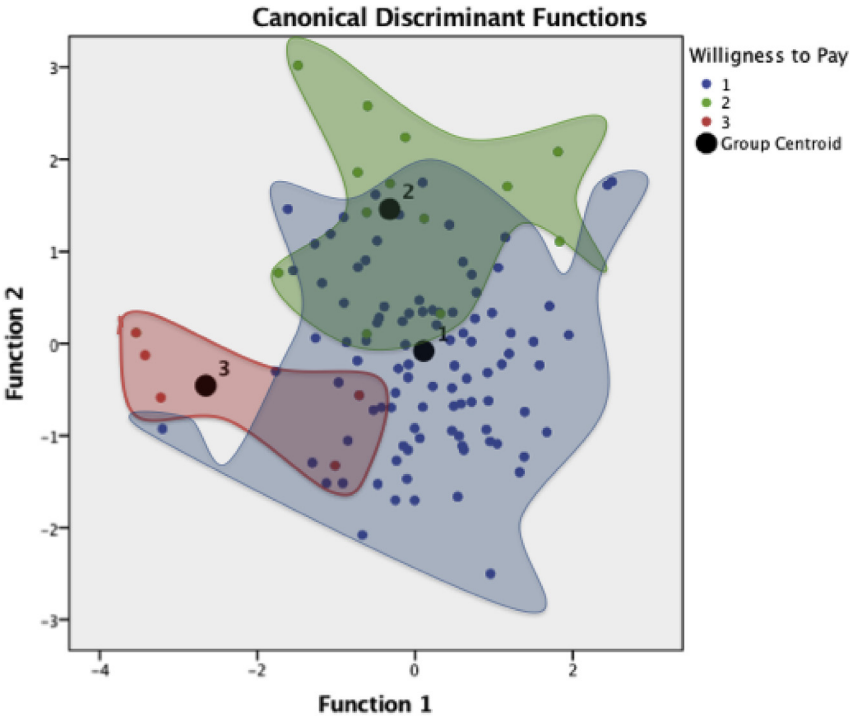

Fig. 7. Canonical Discriminant Analysis. for respondents WTP and WtCT transformed into monetary values to manage the *iqoliqoli* (Low (1 = 0–77.3 FJ$/month), Medium (2 = 77.4–154.6 FJ$/month), High (3 = 154.7–232 FJ $/month)) The discriminant analysis, based on the 29 variables correctly a posteriori classified 92.2% of the respondents.

Table 5
Largest correlation between each variable and discriminant function for WTP and WtCT for management of the *iqoliqoli*. Bolded numbers are WTP and WtCT motivator variables.

MPA variables	Functions	
	1	2
FLMMA Community	**.453**	**−.664**
Remote Island Community	**.478**	**−.661**
Youth	−.307	**.869**
Head of Village	.082	**.471**
Household (Women)	−.185	**.683**
Researcher	**.652**	.024
Employment	**−.409**	−.266
Increase fish size	**−.420**	**1.037**
More fish	**.658**	**−.764**

Table 6
Summary of mean WTP and WtCT for MPA management estimated in FJ$ using a minimum wage rate (FJ$2.32/hr) and scaled up to one year. Bullet points explain some of the variables considered for aggregating estimates of WtCT and WTP.

WTP estimates	WTP FJ$ (community)	WtCT FJ$ (wage rate)
WTP per individual per week	2.38	10.26
WTP per individual per month	9.5	46.25
WTP per individual per year	114.00	554.94

WTP/WtCT calculate over six days per week (Sunday is day of rest) for community.

4.1. Inshore Marine Protected Area benefits

Data derived from the survey was used to assess benefits most important to stakeholder groups. The higher the ranking of benefits by recipient stakeholders, the more willing and self-reliant they could be in managing MPAs long-term. Ranking scores can be easy to carry out but often asking respondents to rank MPA benefits lacks a certain amount of confidence in perceived responses (Malczewski, 1999). Despite this, frameworks to develop MPA benefit assessments have been used, specifically that of The Economics of Ecosystems and Biodiversity (TEEB) (O'Garra, 2012; Ring et al., 2010; Nelson, 2013). To validate respondents understanding of benefits posed, follow up questions were used to test variability and relevance of answers given. The most important MPA benefits reported by interviewees included income, standard of living, and increase in fish. Using these results, scientists and conservationists alike can encourage long-term community and government support in financing inshore MPAs.

That being said, although respondents lack of regard for 'national commitment' seemed unusual, it was supported by Fijian coastal community's open-ended answers. Respondents answers suggested the lack of regard for national commitment at a local level should be the focus for the national governments MPA goals. This is because local governance systems are controlled by customary tenure which exposes local stakeholders lack of obligation to national or international commitments.

According to Thaman et al. (2016), a more holistic approach to conservation would inspire local communities and safeguard the successful implementation of MPA networks. Herewith, MPAs involving local communities provide significant benefits, including increased success, cost-effectiveness, a sense of ownership of marine resources and, conservation initiatives (Gurney et al., 2016). Although MPAs are clearly a valuable tool for conserving the environment, MPA managers need to contemplate how the conservation of these spaces may affect the people who benefit from them, and how consumers, sequentially, impact those spaces (Coulthard et al., 2017). This study indicates that solutions to marine conservation can be found locally, by considering stakeholders differing priorities and empowering local communities. Knowledge of these benefits can inform future policy of the value inshore MPAs have for communities. This could be used as a probable support mechanism for sustainability by creating educational tools targeting the importance of conservation marine resources and procure support for the continued existence of MPAs.

4.2. Identifying willingness to contribute time and willingness to pay as MPA financing mechanisms

Developing-economy valuations frequently ascertain that respondents have inclination to contribute time instead of money (Biro, 1998). Hung et al., 2007 conducted a small-scale CV study to observe WtCT or WTP to develop firebreak to minimize forest fires in Vietnam. This study draws on the same conclusions stating that the frequency of respondents WtCT to protect a community MPA is increasingly higher than their WTP. What seems to be happening is, due to lack of income, and disconnect between governance levels, community stakeholders are unable or unwilling to pay for MPAs (Ahmed et al., 2004). Instead, respondents WtCT as a payment vehicle was motivated by their reliance of marine resources for subsistence livelihood. This is supported by many community MPAs reliant on residents' voluntary labor for implementation such as FLMMA.

Since community stakeholders like local fishers would likely not invest actual cash resources alternative financing mechanisms must be considered. This is due to an expected trade-off between buying children school supplies, paying for transport to get produce to a market or, paying for healthcare (Coulthard et al., 2017). Therefore, this study identifies the income constraints of community stakeholders living subsistence or semi-subsistence livelihoods. This has interesting follow on implications for potential means of financing MPAs. Specifically, how WtCT was found to be a suitable indictor for socio-cultural benefits behind inshore marine environments but also understanding social demand and priorities for conservation in these environments.

4.3. Implications of WtCT and WTP for Marine Protected Area management and policy

A critical concern this study addresses is how to achieve sustainability of locally managed MPAs in developing countries. This study concludes that coastal communities are willing to voluntarily supply labor over money to help in protecting, monitoring and sustaining the use of marine resources. The significant positive relationship of respondents having a higher WtCT than WTP for MPA management is consistent with the results of García-Llorente et al., 2016. However, in this study, due to lack of market, the more rural the community (Gua Island), the higher respondents WtCT value. People that rely heavily on marine resources and have an 'ownership responsibility' display socio-cultural factors which result from consumer preferences consistent with other studies (Starkhouse, 2009). Due to income constraints, WtCT can be used as an eliciting method for stated preference studies in SIDS (Ferreira et al., 2017). Rather than expressing value for the good, respondents may be expressing their opinions of the scenario (Villegas-Palacio et al., 2016).

However, current literature shows concern over cash resources being required for MPA management (Wiener et al., 2016). That being said, financing can come from alternative mechanisms such as the previously used Good Will Payments (Gutman, 2003). These payments provide *iqoliqoli* owners varying levels of 'goodwill' payments shared with the community (Lal et al., 2001). A standard payment has been a year's rent by stakeholders such as fishermen, tourism organizations and hotels.

Within a contemporary setting, WtCT and WTP results could be used to encourage policymakers to integrate local means of supporting the finances of a MPA network. Since these values are elicited from communities whom have traditional ownership of the environment, there is greater assurance that the estimated results are applicable when disseminating research for policy recommendations. For example, the MPA preservation value elicited by asking WtCT is more than four times the value elicit by WTP through a dichotomous approach. Both estimates seem plausible considering the subsistence state of study sites and local stakeholders, and comparability of results to previous estimates (Leisher et al., 2012). When assembling financing mechanisms to reach the MPA goals, alternative-funding opportunities that consider income constraints should be considered.

4.4. Variables influencing community stakeholders WTP and WtCT to manage inshore Marine Protected Areas

Given that proximity to a fishing market or lack thereof, dependence on marine resources, food security and income are variables most influencing WtCT and WTP, respondents are conveying a willingness to contribute work-time (Gibson et al., 2016). Similarly, O'Garra (2009) attributed time not spent managing the MPA to livelihood generating activities for income, food and community benefits. As Fiji begins to scale up from individual MPAs to a national network, financing strategies involve trade-offs, such as expressing WtCT as a contribution to work time (O'Garra, 2012). Thus, individuals WtCT and WTP is considered an opportunity cost in financing and managing inshore MPAs. Additionally, 'commercial fishing communities' with both high (Macuata & Navakavu) and low (Gau Island) levels of fishing market are considered an important variable for WtCT and WTP. Gau Island does not have a fishing market which might decrease opportunity costs of time (Turner et al., 2007). This would lead to increase preference for money in Macuata and Navakavu communities reliant on fishing income because of nearby markets (Gillett et al., 2014). Evidently, in this context, several of the difficulties using money are related to the experiences or lack thereof of respondents replacing marine resources with capital (Vondolia et al., 2014). One of the main challenges for effective MPA conservation measures in Fiji is the high dependence and poverty of many coastal communities. This forces local stakeholders to look elsewhere for monetary compensation of MPAs. Successful conservation and financing of MPAs centres on approval, contribution and buy-in from resource stakeholders (Teh et al., 2018). This can be used to establish the foundation for the model of financing approaches that are considered to be essential for long-term conservation planning.

Current literature supports our use of non-monetary payments as three quarters of respondents were unwilling to pay for MPA management complements (Gibson et al., 2016). This is consistent with community stakeholders having little consideration for payment vehicles because wellbeing becomes the priority when selecting WTP or WtCT (Coulthard et al., 2017). However, when considering stakeholders with an independent income outside of the community (artisanal and commercial fishermen), they have reliable source of income and thus WTP can be a consideration when financing inshore MPAs (Gibson et al., 2016). That being said, there is a gap in our understanding of stakeholders' motivation in choosing WtCT or WTP. The cross-comparative snapshot of this study does not capture the evolving dynamics of community priorities for marine resources (Turner et al., 2007). Or, the wide variation in unevaluated contextual variables (e.g., form of government, level of development, etc.) that might influence individual or community perceptions of MPAs (Diedrich et al., 2017).

A considerable limitation of WtCT is the income constraint. The survey design may not present an incentive compatible mechanism to fund MPAs. Given the relatively more abstract concept of WtCT, measuring the economic contribution inshore MPAs make to social and economic well-being enables informed trade-offs to be made in MPA finance planning (Teh et al., 2018). Thus, facilitating stakeholder support and their potential contribution to effective long-term MPA management may also provides incentive for more effective stakeholder participation. However, further analysis should consider stakeholders level of compliance. This would allow one to evaluate more effectively the mechanisms to successfully finance a MPA network.

4.5. Comparative analysis with Tanya O'Garra (2009)

A comparative analysis between O'Garra and this study contributes to our understanding of the CV approach used in SIDS communities. This comparison furthers our understanding of the changing

preferences in MPA management over time. Respondents in both studies were asked whether they have a preference to contribute money rather than time towards conservation of a MPA for future generations. The shared similar values of O'Garra's results (91.7% of respondents WtCT) and this study (93.6% of respondents WtCT) is not significant. However, the 10-year gap in findings suggests that income and time as MPA financing factors have not changed significantly. Both studies use non-monetary techniques bringing to the discussion multiple MPA benefits (i.e. cultural, educational, moral and spiritual).

The acceptance of time as a financing vehicle may be due to the social and communal obligations imposed on individuals in Fijian communities. Thus, the value respondents put on time versus money has not changed. This further develops our understanding of how people react to conservation mechanisms and their knowledge of the resources in question. Both studies support the conclusions that people tend to know more about topics they care about or have experience with, like an *iqoliqoli* (Hanley et al., 2017). We can deduce from these studies that respondents level of knowledge regarding marine resources is often correlated with their WtCT or WTP and thus forms of payments for MPA financing should be more flexible.

4.6. Provincial trust fund

Consideration of multiple financing options for MPAs in Fiji may include National Trust Funds, Payment of Ecosystem Services and User Fees. In order to obtain more data for informed sustainable MPA financing decisions, Fiji's government may consider the use of Provincial Trust Funds (PTF). PTFs are an international conservation tool that have the potential to lead to financial sustainability through the diversification of financing mechanisms. They can also help strengthen collaboration and build institutional capacity at local and national levels (Yang et al., 2015). The PTF will serve as a tool for financial administration and an intermediary between resource users and those protecting resources. For example, in Kiribati, the Phoenix Islands Protected Area uses PTFs as an economic incentive scheme. It acts as an intermediary to generate and channel funds from donors to the providers of ecosystem services (Govan, 2015). In Fiji, key informants from Ministry of Fisheries mentioned that budgetary allocation for 2016–2017 does not consider funding for MPAs (Ministry of Finance, 2016). Such financing models have the ability to increase government expenditure through the national budget based on the proportion of funds (WtCT) each stakeholder is willing to contribute (Seenprachawong, 2016).

While PTF appears to be a likely alternative for financing MPAs the uncontrolled development of consumptive use and exploitation of marine resources may lead to negative consequences for MPA financing. MPA financing is undertaken by many parties rather than through limited national-scale initiatives. Although PTF uses community-based approaches which may offer the most feasible way to reach international obligations, questions are raised concerning how MPAs should be financed and how costs and benefits of their formation can be allocated fairly. The relatively high valuation of respondent WtCT versus WTP should provide motivation for the private sector and other local resource users to become more endowed in MPA conservation.

Beneficiary groups were demonstrative of the preference of key stakeholders whom could support inshore MPA network financing. Due to the influx of respondents WtCT for MPA management a PTF is considered a feasible way in which beneficiary groups can support MPA financing. Within Fiji, bottom-up approach to management of inshore MPAs has proven to be increasingly successful (Govan, 2015). In the case of PTF, concern as to whether inshore benefits will motivate beneficiaries to conduct MPA management activities pertaining to results of WtCT is questioned. Evidence from our interviews suggest that, given the low WTP compared to the opportunity costs of marine resources, protecting beneficiaries inshore marine environment is a more economically attractive possibility for beneficiaries than participating in payment methods. This highlights that creating the right incentives (whether monetary or non-monetary contingent upon society and environment) is therefore important if the PTF system is to be successful and fair.

One limitation of WtCT is reliance on external funding for the PTF. The use of Payment for Ecosystem Services (PES) where identified beneficiaries provide direct incentives to sellers was considered as an alternative financial mechanism (Arlaud et al., 2018) Currently, there are voluntary access fee payments in several dive tourism hotspots when entering community-managed MPAs (Brunnschweiler, 2010). These access fees are distributed to local traditional fishing rights owners to use at their discretion for management costs; community-development projects; and children's education. However, it is now illegal under the Regulation of Surfing Areas Decree 2010) to make compensation payment for accessing marine spaces for water sports making PESs unattainable as a national scheme (Ponting and O'Brien, 2014).

It was considered by beneficiaries and government representatives that collecting licensing fees from artisanal fishers could be used as “payments” incentives for beneficiaries who were WtCT to manage the MPA network. By compensating for the abstraction of one resource we can conserve another (Spergl and Moye, 2004). However, as mentioned by key informants at the Ministry of Economy, previously, all funds collected through licensing fees and user fees, were dispersed as the government saw fit and placed into a consolidated fund (Bell, 2001). A concern is that the returns from the consolidated fund will be diluted through government policy and thus, the funds considered for a PTF will not be directly distributed for this objective (Drew, 2011). Thus, it is recommended that licensing fees for inshore marine environments should go directly to a PTF instead of a national consolidated fund. By considering a hybrid institution of customary management (WtCT) and national governance (PTF) we move away from the top-down centralized systems of MPAs (Cinner and Aswani, 2007) with the aim to increase compliance and subsequent conservation efforts.

This emphasizes how future MPA financing in Fiji has to occur within economic limits such as through tourist user fees. In the broader context, this study highlights the potential economic benefits that can be realised from MPAs if there are effective governance bodies in place to assist socio-ecological and human well-being of coastal communities. That being said, the use of PTF is inspired by the need to better understand the contributive behaviour of marine resource users to collectively sustain the conservation of coral reef public goods.

5. Conclusion

Our study reveals there is discrepancy between the WtCT and WTP driven by income constraints, which then has follow on implications on potential means for providing MPAs. WTP and WtCT could support the identified annual costs of a MPA network by considering the benefits attributed to subsistence and commercial fishers. In other words, this study illustrates that the benefits of MPAs must be considered when implementing and managing sustainable financing of a MPA network. Our results show that multiple drivers of MPA benefits interact with recipient stakeholders. This potential can be identified through a financial lens which promotes an equitable and benefits-based contribution to the MPA network. It has a polycentric governance array which strongly endorses the traditional fishing communities and the FLMMA approach. This is contrary to a mechanism in which the MPA network is funded directly and centrally through the domestic budget which is the predisposition of many western MPA approaches (e.g. Nature 2000 in Europe) and consideration by western-style agents in the Pacific region.

With heavy pressures on the Fiji national budget and ongoing economic impacts being felt from Tropical Cyclone Winston, but a national commitment to progress a national MPA network, a polycentric sustainable financial approach would seem to provide an option within

these constraints. This may be timely as the Pohnpei Ocean Statement: a Course to Sustainability from regional leaders in September 2016 concludes that “To ensure no one is left behind, we must embrace transformative change and action now”.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.ocecoaman.2018.07.011.

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